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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/686,323	10/09/2000	Bin Zhao	97RSS433DIV	6870

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EXAMINER	
PERALTA, GINETTE	
ART UNIT	**PAPER NUMBER**
2814	

DATE MAILED: 07/28/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application N .	Applicant(s)	
	09/686,323	ZHAO, BIN	
	Examiner	Art Unit	
	Ginette Peralta	2814	

-- Th MAILING DATE of this communication appears on the cover sh et with the correspondence address --

Peri d f r Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 July 2003* .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *93-117* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *93-117* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☒ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. Claims 93 and 105 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In claims 93 and 105 it is recited a method of manufacturing an interconnect that includes "forming a first air gap, a second air gap, and a support pillar in said first hard mask and said first insulating layer, said support pillar being situated between said first air gap and said second air gap, said support pillar, said first air gap, and said second air gap being situated in said trench, said support pillar being in contact with said first interconnect line"; it is noted that according to the drawings submitted by the applicant, there is no single embodiment in which the support pillar is simultaneously in the trench between two interconnect lines and situated between a first air gap and a second air gap, which are located in the same trench, while being in contact with the first interconnect line. It is further noted that if the support pillar is between the first and the second air gaps, and that if the trench is located between a first and a second interconnect, then the support pillar would not be in contact with either the first or the second interconnect or if it is in contact with one of the interconnects then one of the air

gaps is not situated in the trench between the first and second interconnect lines, therefore this limitation is indefinite. It is examiner's understanding that the support pillar, the first air gap, and the second air gap are situated in a trench between a first and a second interconnect line.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 93-117 are rejected under 35 U.S.C. 103(a) as being unpatentable over Michael et al. in view of Chen et al..

Michael et al. discloses in col. 5, line 10-col. 7, line 57, a method of manufacturing an interconnect that comprises forming a first patterned layer of conductive material 11, the firs patterned layer having at least one trench situated between a first and a second interconnect line; depositing a first insulating layer 20 over the first patterned layer 11, the insulating layer filling the at least one trench; forming a first air gap, a second air gap, and a support pillar in the first insulating layer 20, the support pillar being situated between the first air gap and the second air gap (figs. 6 and 7), the support pillar, the first air gap, and the second air gap being situated in the trench, it is further taught that a support pillar is in contact with the first interconnect line (as shown in fig. 6) when

other gaps are formed in the structure; depositing a sealing layer over the first insulating layer to seal the first air gap and the second air gap, wherein the first insulating layer of Michael et al. comprises silicon oxide.

Michael et al. discloses the claimed invention with the exception of depositing a first hard mask on the first insulating layer and forming the first air gap, the second air gap and the support pillar on the first hard mask.

Chen et al. discloses in col. 3, line 36- col. 4, line 13 a method of manufacturing an interconnect that comprises depositing a first insulating layer 24 over the substrate 20; depositing a first hard mask 26 on the first insulating layer; and forming a trench in the first hard mask and the first insulating layer; wherein the first insulating layer 24 comprises a low-k dielectric material used as a replacement for silicon oxide in order to further improve performance of the integrated circuits(col. 1, ll. 26-46), and the first hard mask is used to protect the low-k dielectric material that may exhibit patterning problems because of their low etch rate selectivity with respect to photoresist(col. 1, ll. 47-56).

Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a low-k dielectric material as the first insulating layer for the disclosed intended purpose of Chen et al. of further improving the performance of integrated circuits, and to deposit a first hard mask over the first insulating layer for the disclosed intended purpose of protecting the first insulating layer that may exhibit patterning problems because of their low etch rate selectivity with respect to

photoresist. Furthermore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use a combination of an insulating material with a hard mask layer as taught by Chen et al. instead of the silicon oxide layer taught by Michael et al. , since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. *In re Leshin*, 125 USPQ 416.

With regards to the feature of applying a photoresist material to the first hard mask and etching the first and second air gap in the first hard mask and the first insulating layer, Michael et al. discloses in col. 6, ll. 10-32, that the step of forming a first air gap and a second air gap comprises a masking step and an etching.

With regards to the feature of opening a via hole in the sealing layer, the first hard mask, and the first insulating layer, Michael et al. discloses in fig. 12 that the method further comprises opening a via hole 46 in the sealing layer and the first insulating layer. Michael et al. as modified by Chen et al. would teach that the via hole 46 is also formed in the first hard mask.

With regards to the feature of the steps of forming the via hole, Michael et al. discloses in col. 7, ll. 19-52, that in order to open the via hole in the sealing layer, and the first insulating layer a trench mask is applied defining a via hole pattern, and etching a via hole in the sealing layer and the first insulating layer based on the via hole pattern.

With regards to the feature of forming a conductive plug and forming a second patterned conductive layer, Michael et al. discloses that a conductive plug is formed in

the via hole 46; and forming a second patterned layer 40 of conductive material over the sealing layer 30.

With regards to the feature of depositing a second insulating layer over the sealing layer, Michael et al. as modified by Chen et al. discloses in col. 7, ll. 12-17 that an additional insulating layer could be formed prior to the step of forming the via hole, and when this additional insulating layer is included the via hole would be formed through the second insulating layer, the sealing layer, and the first insulating layer. Michael et al. as modified by Chen et al. discloses that use of a combination of insulating layer and hard mask layer, thus it would have been obvious to one of ordinary skill in the art at the time the invention was made to form a second hard mask layer over the second insulating layer for the previously disclosed intended purpose of Chen et al. of protecting the underlying insulating layer during the etching step.

With regards to the feature of the sealing layer and the insulating layer comprising a low dielectric constant material, Michael et al. discloses the use of silicon oxide for the sealing layer, Chen et al. discloses that low dielectric constant materials are being used as replacements for silicon oxide in order to improve the performance of the integrated circuits. Thus, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a low dielectric constant material as the sealing layer in the invention of Michael et al. for the disclosed intended purpose of Chen et al. of improving the performance of the integrated circuit.

With regards to the feature of the conductive material, Michael et al. discloses that the first patterned layer of conductive material comprises aluminum. It would have been obvious to one having ordinary skill in the art at the time the invention was made to any of the well known and widely used conductive materials including polysilicon, titanium, titanium nitride, tantalum, tantalum nitride, tungsten, copper, and aluminum, since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

Response to Arguments

5. Applicant's arguments filed 7/7/03 have been fully considered but they are not persuasive.

With regards to applicant's argument that Michael et al. does not show a pillar in contact with an interconnect line, it is noted that in Fig. 6, Michael et al. shows a pillar 20 in contact with the interconnect line 11, furthermore it is acknowledged that Michael et al. discloses that the air gaps (trenches) are placed indiscriminately with respect to first interconnect lines 11, but it is also noted that this does not exclude forming the support pillars in contact with the interconnect lines or between the first and second air gaps located in the trench that is between the first and second interconnect lines. .

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ginette Peralta whose telephone number is (703) 305-7722. The examiner can normally be reached on Monday to Friday 8:00 AM- 5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached on (703) 308-4918. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7724 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

GP
July 23, 2003

SUPERVISORY PRIMARY EXAMINER
TECHNOLOGY CENTER 2800